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F42B 12/56

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F3A A2B21

(56) Documents Cited
GB 2246420 A GB 2012028 A GB 2011619 A
EP 0061398 A US 4999816 A

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INT CL^5 F42B , G10K , H04R
Online:WPI

(54) Gun launchable sensor

(57) A sensor of the sonobuoy type is packaged in a shell-like housing (7) so that it can be deployed by firing from a gun in the manner of a round of ammunition. As the shell enters the water, an input sensor (10) causes a package (8) containing the sonobuoy to be ejected from the shell. The package sinks, and at a predetermined depth, a pressure sensor causes the sonobuoy to be ejected from the package, the sonobuoy float inflating and rising to the surface. The sonobuoy may include a receiver for GPS or OMEGA transmissions which allow its point of deployment to be positively ascertained even though it is out of visual range. The hydrophone may be responsive to phenomena other than sound and may include or be replaced by an acoustic or other radiation-producing source, or may be omitted entirely.

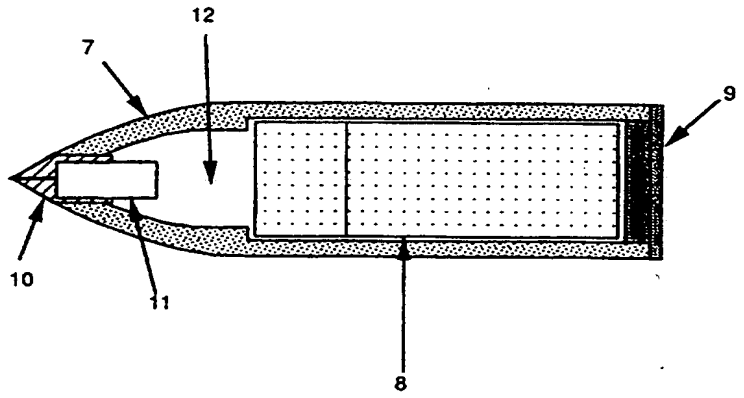

Figure 2

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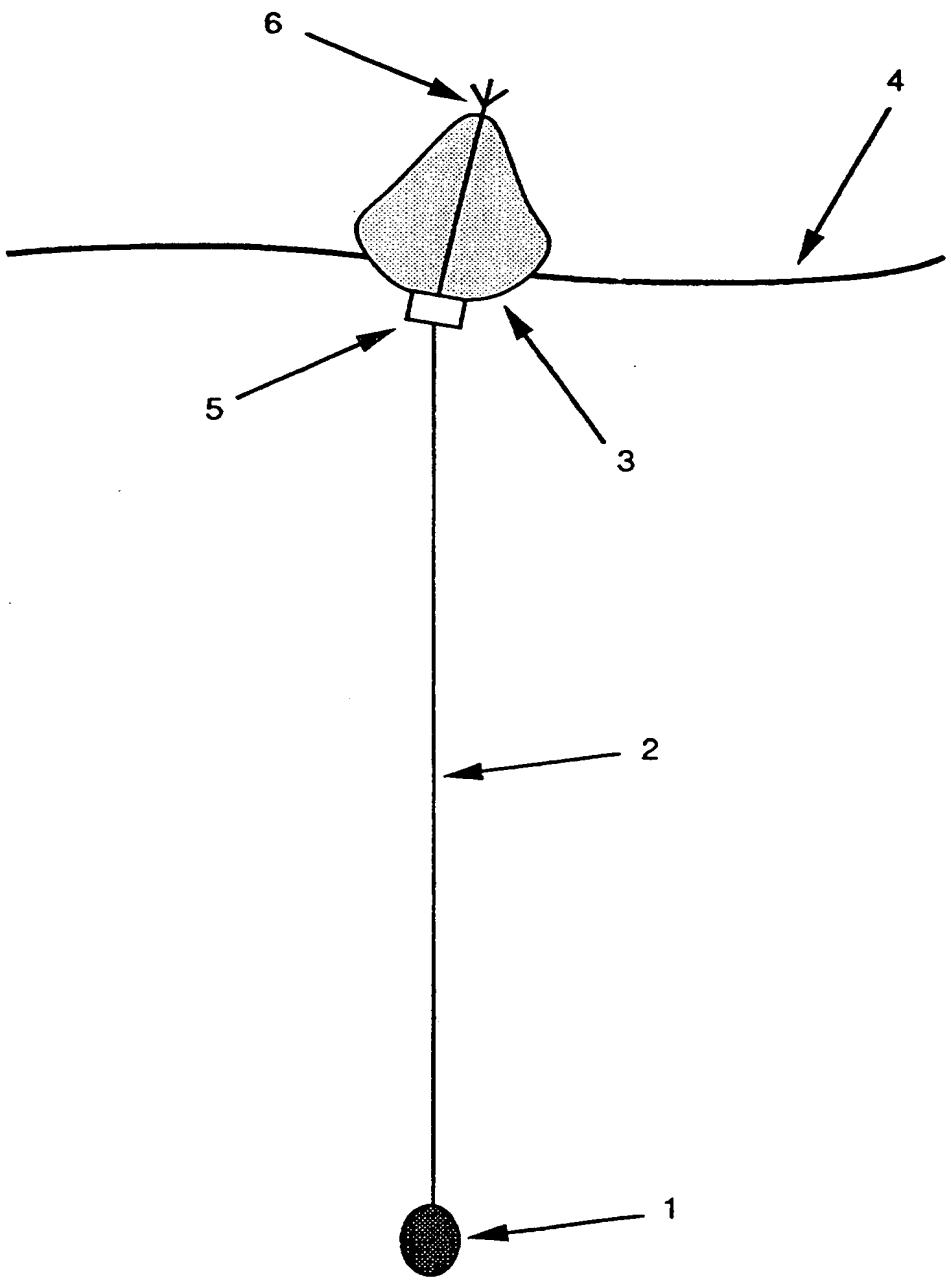


Figure 1

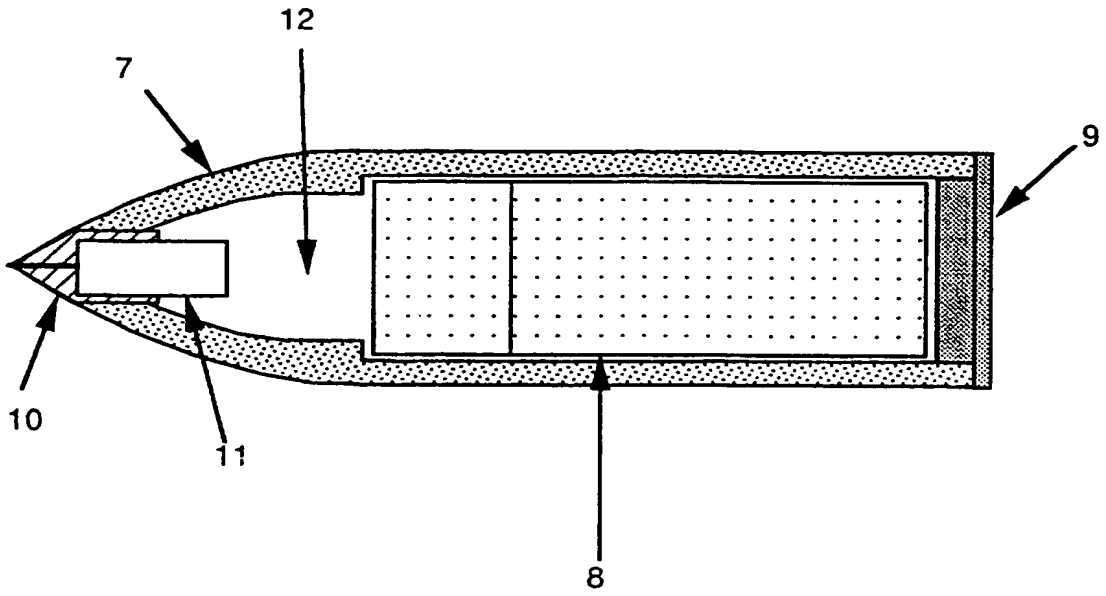


Figure 2

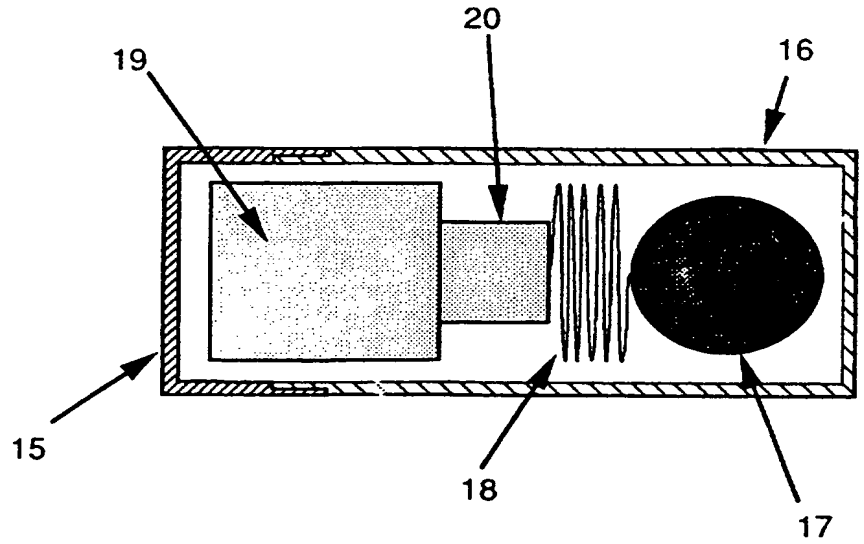


Figure 5

Figure 3a

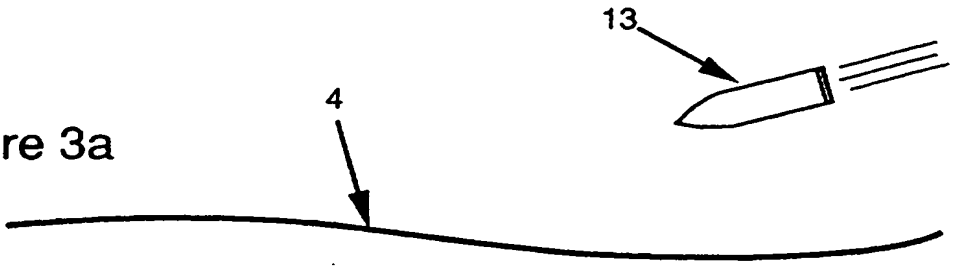
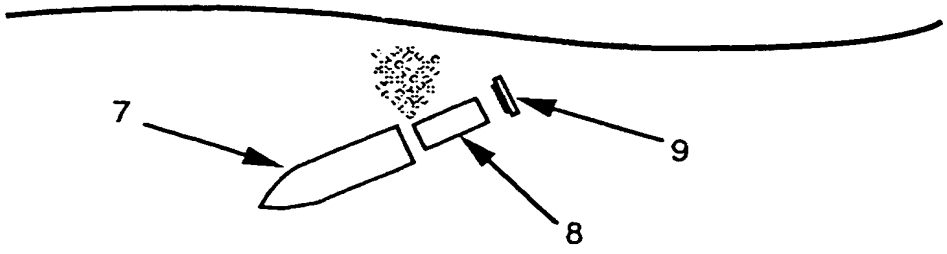


Figure 3b

Figure 3c



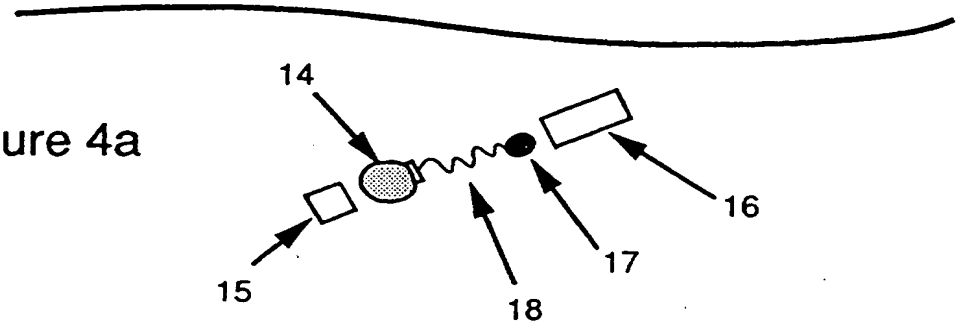


Figure 4a

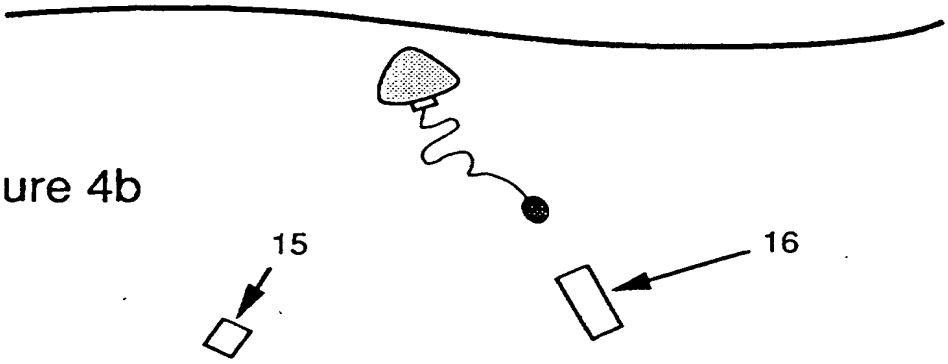


Figure 4b

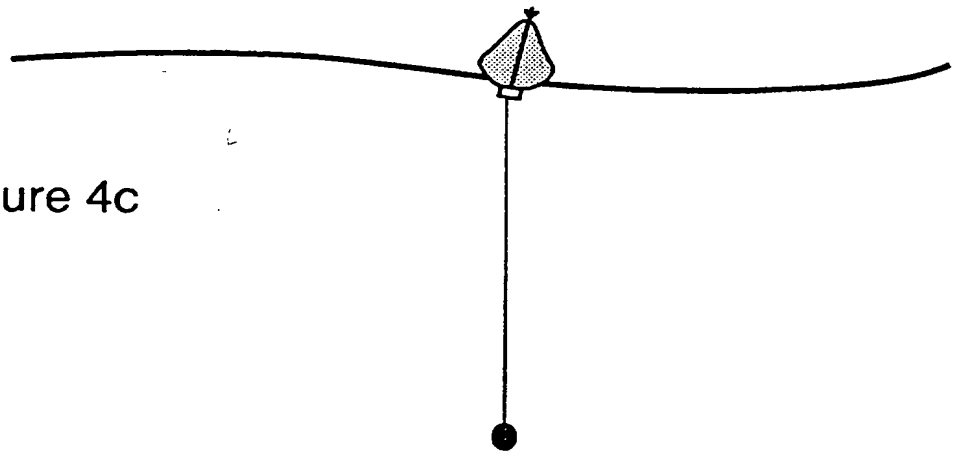


Figure 4c

GUN LAUNCHABLE SENSOR

This invention relates to a gun-launchable sensor. More particularly, this invention relates to a sensor of the sonobuoy type which can be deployed by firing from a gun.

For the purposes of this specification, sensors of the sonobuoy type include but are not limited to, passive sonobuoys comprising a float from which is suspended a hydrophone responsive to sound; sensors in which the hydrophone or equivalent is mounted directly on the float; passive sensors which are functionally equivalent to sonobuoys, but responsive to phenomena other than sound, active sensors incorporating both a transmitter which radiates energy, and a receiver responsive to energy; and sensors which only radiate energy.

In one type of conventional sonobuoy, shown in Figure 1, a hydrophone with receiver electronics 1 is suspended by a cable 2 from a float 3 floating on the surface of the sea 4. The cable 2 is coupled to a transmitter electronics module 5 also carried by the float 3. The transmitter electronics module 5 converts signals received at the hydrophone 1 into radio frequency signals which are

transmitted by antenna 6. As is usual in such sonobuoys, the float has an arrangement, not shown, which causes the float to deflate when the sonobuoy is no longer required. This may be activated by a timer or other mechanism.

Such sonobuoys commonly are deployed by dropping from a helicopter, or fixed wing aircraft, the radio signals from the buoy being monitored by the launching aircraft. As this requires radio communication to be maintained for the operating lifetime of the buoy the aircraft is restricted in its movements and the total area of sea under investigation at any particular time is somewhat limited, giving a high overall cost for operation. Monitoring of buoy transmissions by a surface vessel would be of considerable advantage as this would free the aircraft for other duties following buoy delivery. However, deployment of buoys from the ship itself would severely limit the area of sea which could be investigated if this deployment involved either dropping buoys over the ship's side or delivery by means of a mortar. Longer range and more rapid delivery could be achieved by use of rocket deployment, but this would be expensive and somewhat limited in accuracy.

It would be advantageous to be able to deploy sensors of the sonobuoy type accurately over a relatively large area

in a very short time at comparatively low cost.

The present invention seeks to provide a solution to this problem.

In accordance with the invention, a gun-launchable sensor assembly comprises a shell-like outer casing and a sonobuoy arrangement disposed within the shell-like outer casing. This allows the sensor to be deployed by, for example, a standard Naval gun.

As well as providing an economical and rapid means of deployment over a wide area, it permits deployment under conditions where deployment by aircraft or motor launch are difficult, such as at night or in fog or stormy weather.

The sensor assembly may comprise means to deploy the sonobuoy on submergence thereof. The sonobuoy arrangement may comprise a container and a sonobuoy disposed within the container. The sensor assembly may comprise a first means to eject the sonobuoy arrangement from the shell-like outer casing. The sensor assembly may comprise second means to eject the sonobuoy from the container. The first ejection means may comprise an inertia sensor. The second ejection means may comprise a pressure sensor.

The sonobuoy may comprise means to receive broadcast transmissions, such as transmissions from Global Positioning Satellites, or VLF Navigation transmissions such as the OMEGA Navigation broadcasts, and may comprise means to determine the absolute geographical position from the broadcast transmissions thus received. The sonobuoy may thus be enabled to determine its position and to include data indicative of its position in its own transmissions back to the ship which deployed it.

The sonobuoy may comprise a hydrophone. The hydrophone may be responsive to sound. The hydrophone may alternatively or additionally incorporate sensors responsive to phenomena other than sound, such as electromagnetic radiation or magnetic flux. This allows submarine craft to be detected by their magnetic signature or emissions detectable by the extra-low frequency effect. Alternatively, the hydrophone may be omitted. Such an arrangement could be used to check the accuracy of the gun.

The sonobuoy may comprise means to produce active sonar transmissions. This allows the detection, classification, and tracking of an underwater craft by the echoes from such transmissions.

The foregoing and other features according to the invention will be better understood from the following description with reference to the drawings in which:

Figure 1 shows a prior art sonobuoy in its deployed state;

Figure 2 shows an embodiment of the invention;

Figures 3 and 4 show stages in the deployment of an embodiment of the invention; and

Figure 5 shows an embodiment of a packaged sonobuoy assembly for use with the invention;

In Figure 2, the hollow casing 7 of a shell contains a packaged sonobuoy 8 which is sealed in the casing 7 by an end-cap 9. The casing 7 is dimensioned so as to allow it to be fired from a standard naval general-purpose gun in the manner of a round of ammunition. The shell has a fuse-head 10 arranged to activate an ejection means 11, which in a preferred embodiment comprises a compressed gas container. When fuse-head 10 is initiated in the manner outlined below, pressurised gas is released into the space 12 within the

casing, the resulting pressure build-up causing the end-cap 9 to release, this and the sonobuoy package 8 then being expelled from the shell casing 7.

The mode of deployment of the invention following launch, through to water entry and payload release is illustrated in Figure 3. In Figure 3a the shell 13 with its packaged sonobuoy payload is fired from a gun and follows a ballistic trajectory through the air to its intended point of operation. In Figure 3b the shell is shown passing through the sea surface 4. In Figure 3c the retardation shock of water entry initiates the fuse-head 10, which leads to release of the sonobuoy package 8. The fuse-head 10 is initiated by an inertia sensor, not shown, responsive to the retardation shock deceleration. The shell casing 7 and end-cap 9 take no further part in the operation, and fall to the sea bed.

Subsequent stages in the deployment of the sonobuoy package 8 itself are shown in Figure 4. The package 8 is non-buoyant and hence sinks until a predetermined depth is reached, at which point a pressure sensor, not shown, initiates separation. As shown in Figure 4a, the float 14 starts to inflate, forcing off the package end-cap 15 which falls away. The main body of the container 16 is also

released and separates from the hydrophone 17 and the attached cable 18. The float continues to inflate and rises to the surface, as shown in Figure 4b, while the hydrophone sinks under its own weight. Eventually the float surfaces and the sonobuoy is fully deployed and operational, as shown in Figure 4c. Different lengths of cable may be used for buoys designed for shallow and deep water operation.

The packaged sonobuoy is shown schematically in Figure 5. The container is in two parts 15, 16 the end-cap 15 being forced off when inflation of the float is initiated. A composite unit 19 contains the float and antenna, which are folded prior to deployment and are linked together such that, as the float is inflated, it erects the radio antenna. Also included is a compressed gas system for inflation of the float. These items are attached to the electronics module 20, which contains transmitter circuitry, together with batteries for powering the sonobuoy. The electronics module is linked to the hydrophone 17 via the suspension cable 18. The main body of the container 16 also separates from the sonobuoy, falling away initially under the influence of drag and subsequently its own weight as the float exerts an upwards pull on the buoy.

Components within the sonobuoy are packaged so as to

withstand the extremely high forces associated with longitudinal acceleration and body spin-up during the discharge from the gun. The mounting of the packaged sonobuoy within the shell casing is designed to minimise the effects of such forces on the container. Such protection operates during the rapid deceleration at water entry, and involves techniques such as use of encapsulation within resilient potting compound and design to minimise shock loading on sensitive components.

A number of modifications are possible within the scope of the invention. While the invention has been described with reference to a sonobuoy, it is not limited to the arrangements described.

In one modification, not shown, the hydrophone may be replaced by a sensor comprising electrodes for detection of an underwater craft by means of the Extra-Low Frequency Electrical effect (ELFE). In another modification, not shown, the hydrophone may be replaced by a magnetic sensor. This can be used to detect an underwater craft by its magnetic signature.

Another modification, not shown, uses a modified antenna or an additional antenna to receive radio

transmissions which allow absolute global position of the sonobuoy to be determined. Such signals may, for example, comprise transmissions from satellites, such as the so-called GPS transmissions or VLF Omega navigation transmissions. By retransmission of appropriate data, the position of the sonobuoy may be accurately estimated by the monitoring ship or aircraft. This is particularly advantageous where tracking is required of the sound source being monitored by the sonobuoy, and avoids uncertainty as to the actual point of depolyment. It also minimises problems which would otherwise result from effects of ocean currents, tides and winds on the sonobuoy position during its period of operation, and is particularly beneficial when the sonobuoy is deployed at long range.

In a further modification, not shown, the hydrophone assembly may be omitted. Such an arrangement can be used solely as a means of checking the accuracy of the launching gun at different ranges. In this implementation transmissions from the buoy may includes data indicative of the buoy position, which will be approximately equal to the point of impact of the shell with the sea, global position data being obtained from suitable received radio transmissions. Alternatively, conventional RDF techniques may be employed.

In another modification, not shown, the hydrophone may be replaced by a sound transmitting transducer and associated power supply, the device providing a sonar source capable of accurate delivery from a ship for the purposes of active bistatic sonar operation. One such active buoy may act as the sound source for a number of the gun-launched passive sonobuoys, enabling echoes from an underwater craft in the vicinity to be received for detection, classification and tracking purposes. In a further modification the buoy may include both a sound transmitting transducer with associated power supply and a hydrophone assembly capable of monitoring echoes from an underwater craft for detection, classification and tracking purposes.

CLAIMS

1. A gun-launchable sensor assembly comprising a shell-like outer casing and a sonobuoy arrangement disposed within the shell-like outer casing.

2. A gun-launchable sensor assembly according to claim 1 comprising means to deploy the sonobuoy arrangement on submergence thereof.

3. A gun-launchable sensor assembly according to claim 1 or claim 2 in which the sonobuoy arrangement comprises a container and a sonobuoy disposed within the container.

4. A gun-launchable sensor assembly according to claim 3 in which the deployment means comprises first means to eject the sonobuoy arrangement from the shell-like outer casing, and second means to eject the sonobuoy from the container.

5. A gun-launchable sensor assembly according to claim 4 in which the first and second ejection means respectively comprise inertia and pressure sensors.

6. A gun-launchable sensor assembly according to any preceding claim in which the sonobuoy comprises means to receive broadcast transmissions and means to determine absolute geographical position from the received broadcast transmissions.

7. A gun-launchable sensor assembly according to claim 6 in which the receiver means is arranged to receive Global Positioning System (GPS) transmissions.

8. A gun-launchable sensor according to any preceding claim in which the sonobuoy comprises a hydrophone.

9. A gun-launchable sensor according to claim 8 in which the hydrophone comprises means responsive to magnetic flux.

10. A gun-launchable sensor according to claim 8 in which the hydrophone comprises means responsive to electromagnetic radiation.

11. A gun-launchable sensor according to claim 8 in which the hydrophone comprises means responsive to the Extra-Low Frequency effect.

12. A gun-launchable sensor assembly according to any preceding claim in which the sonobuoy comprises means to produce active sonar transmissions.

13. A gun-launchable sensor assembly substantially as described with reference to the drawings.

Amendments to the claims have been filed as follows

1. A gun-launchable sonobuoy assembly comprising a shell-like outer casing capable of being fired from a gun and a sonobuoy package disposed within the shell-like outer casing, the sonobuoy package comprising a sonobuoy sensor as herein defined.

2. A gun-launchable sonobuoy assembly according to claim 1 comprising means to deploy the sonobuoy sensor on submergence thereof.

3. A gun-launchable sonobuoy assembly according to claim 1 or claim 2 in which the sonobuoy package comprises a container and the sonobuoy sensor, the sonobuoy sensor being disposed within the container.

4. A gun-launchable sonobuoy assembly according to claim 3 in which the deployment means comprises first means to eject the sonobuoy package from the shell-like outer casing, and second means to eject the sonobuoy sensor from the container.

5. A gun-launchable sonobuoy assembly according to claim 4 in which the first and second ejection means respectively comprise inertia and pressure sensors.

6. A gun-launchable sonobuoy assembly according to any preceding claim in which the sonobuoy sensor comprises means

6. A gun-launchable sensor assembly according to any preceding claim in which the sonobuoy comprises means to receive broadcast transmissions and means to determine absolute geographical position from the received broadcast transmissions.

7. A gun-launchable sensor assembly according to claim 6 in which the receiver means is arranged to receive Global Positioning System (GPS) transmissions.

8. A gun-launchable sensor according to any preceding claim in which the sonobuoy comprises a hydrophone.

9. A gun-launchable sensor according to claim 8 in which the hydrophone comprises means responsive to magnetic flux.

10. A gun-launchable sensor according to claim 8 in which the hydrophone comprises means responsive to electromagnetic radiation.

11. A gun-launchable sensor according to claim 8 in which the hydrophone comprises means responsive to the Extra-Low Frequency effect.

12. A gun-launchable sensor assembly according to any preceding claim in which the sonobuoy comprises means to produce active sonar transmissions.

13. A gun-launchable sensor assembly substantially as described with reference to the drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number 9303571.5

Relevant Technical fields

(i) UK Cl (Edition L) F3A (A2B19, A2B21, A2C, A2D, A2X7) F3C (CDA, CDB, CDC, CDD, CDE) G1G (GEEA, GEEH)

(ii) Int Cl (Edition 5) G10K, H04R, F42B

Databases (see over)

(i) UK Patent Office

(ii) Online database: WPI

Search Examiner

KEN LONG

Date of Search

6 APRIL 1993

Documents considered relevant following a search in respect of claims 1 to 13

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2246420 A (ROYAL ORDNANCE) see page 1 lines 1 to 7 and page 6 lines 8 to 19	-
Y	GB 2012028 A (RAYTHEON) see particularly page 1 lines 5 to 35	1, 2, 8 and 10
X,Y	GB 2011619 A (RAYTHEON) see particularly page 1 line 5 to 10 and 80 to 101	1, 2, 8 and 10
Y	EP 0061398 A1 (BOULARD F) see particularly page 1 lines 3 to 6 and page 4 lines 6 to 28	1, 2, 8 and 10
X,Y	US 4999816 (US NAVY)	1, 2, 8 and 10